Polystyrene Manufacture

There are approximately 21 facilities in Washington under SIC code 3086 Plastics Foam Products (Ecology, 1/20/98).

Description of Process

Polystyrene is produced by the polymerization of styrene monomer (EPA, 1993). Styrene (CAS number 100-42-5) is a colorless liquid that evaporates easily. Expandable polystyrene is produced by introducing a volatile blowing agent which causes the polymer to expand when heated. Polystyrene is foamed through the use of physical blowing agents. Blowing agents are gases or liquids which are soluble in the molten polymer under pressure. Upon depressurization, the blowing agent volatilizes causing the polymer to foam through the formation of gas cells.

Traditionally, polystyrene foam was produced with volatile hydrocarbon blowing agents such as n-pentane, isopentane, and n-butane. Because of their highly flammable nature, they were for the most part replaced by nonflammable chloroflurocarbons (CFCs). However, concerns over the use of ozone depleting CFC-11 and CFC-12 are prompting a return to hydrocarbon blowing agents or other alternatives such as HCFC-22 (EPA, 1990).

Methods of Determining Emissions

There are three major sources of emissions: process vents, storage tanks, and equipment leaks. Secondary sources emissions include transfer and handling operations among others.

Due to the use of highly flammable VOCs each facility had been designed to remove air from the facility quickly. This high air flow hindered the ability to measure emissions accurately. The locations of the fans and vents were also difficult to access. It became clear the emissions were dependant upon the type of manufacturing process used. A literature search identified that "Insufficient information is available to develop emission factors for fugitives or process source emissions" (EPA 1993).

Two different methods could be used to develop these emission factors. One could be the amount of VOC emitted per amount of VOC purchased, the other could be the amount of VOC emitted per amount of product produced. Using available information, the confidence level in emission factors developed in this way range from low to moderate and are based on many complicating factors.

References

Agency for Toxics and Disease Registry, *Toxicological profile for styrene,* Atlanta, GA, 1992.

American Society for Testing and Materials, *Analysis of organic compound vapors collected by the activated charcoal tube absorption method - method D 3687-89,* 1989 annual book of ASTM standards, Vol. 11.03, Philadelphia, PA, 1989b, 244-248. (“”)

Bishop, RB, *Practical Polymerization for Polystyrene,* Boston, Massachusetts: Chaners Books,1971.

Boyd, BP, 1990. *Styrene: Perspectives on the Carcinogen Question*, SIRC Review. Vol 1 No. 1., Washington DC: The Styrene Information and Research Center, 9-23.

Hawley GG, et al, *Hawley's Condensed Chemical Dictionary*, Eleventh edition, New York, NY: Van Nostrand Reinhold Publishing,1987.

U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emissions Factors Volume 1: Stationary Point and Area Sources,* Fifth Edition with Supplements, January 1995, Document No. AP-42. (Section 6.6.3, Polystyrene, September 1991) (available by section on Internet at http://www.epa.gov/ttn/chief/ap42.html)

U.S. Environmental Protection Agency, Control *of VOC Emissions from Polystyrene Foam Manufacturing*, 1990, EPA-450/3-90-020. Office of Air Quality, Triangle Park, NC.

U.S. Environmental Protection Agency, *Locating and Estimating Air Emissions from Sources of Styrene*, 1993, EPA-454/R-93-011. Office of Air Quality, Triangle Park, NC.

Washington State Department of Ecology, *Facility/Site on the Web*, accessed 1/20/98. (http://www.wa.gov/ecology/iss/fsweb/fshome.html)